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The objective of this research effort was to better understand and model influences of the lower atmosphere on the ionosphere-thermosphere system, primarily through numerical simulations involving the interaction between tropospherically-generated gravity waves and large-scale dynamical features in the upper atmosphere.

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**Final Technical Report**

# AASERT96: METEOROLOGICAL INFLUENCES ON THE IONOSPHERE-THERMOSPHERE SYSTEM (F49620-96-1-0299)

**Jeffrey M. Forbes, Principal Investigator, University of Colorado**

**1 July 1999**

**Objectives:** The objective of this research effort was to better understand and model influences of the lower atmosphere on the ionosphere-thermosphere system, primarily through numerical simulations involving the interaction between tropospherically-generated gravity waves and large-scale dynamical features in the upper atmosphere.

**Summary of Findings:** Efforts centered around incorporation of a hybrid Lindzen/Matsuno gravity wave parameterization scheme into the Global Scale Wave Model and using this model to investigate the intraseasonal variability of the diurnal tide and the vertical penetration of the quasi-2-day wave into the thermosphere and ionosphere. The semiannual variation of the diurnal propagating tide in the 80-130 km height regime has been explained in terms of gravity wave interactions with the diurnal tide. Two equally important physical mechanisms connected with gravity waves are involved : (1) the seasonal variation of eddy diffusivity connected with gravity wave breaking; and (2) the deposition of momentum by the gravity waves, which is modulated on a diurnal scale by the tide, and which in fact feeds back to modify the diurnal tidal structure. In addition, it has been shown that by virtue of gravity wave filtering by planetary waves in the stratosphere and mesosphere, that "secondary excitation" of planetary waves in the lower thermosphere occurs, due to molecular dissipation and momentum deposition connected with the gravity waves which "leak through". These simulations of lower thermosphere planetary waves agree with recent measurements, and probably account for much of the planetary wave variability seen in ionospheric measurements.

**Personnel:** Mr. Chris Meyer, Ph.D. candidate in the Department of Aerospace Engineering Sciences; Ms. Kim Cierpik, Ph.D. candidate in the Department of Aerospace Engineering Sciences.

**Publications:**

Meyer, C., Gravity Wave-Tidal and Gravity Wave-Planetary Wave Interactions in the Mesosphere and Lower Thermosphere, Ph.D. Thesis, University of Colorado, 1998.

Meyer, C., Gravity Wave Interactions with the Diurnal Propagating Tide, *J. Geophys. Res., 104(D4),* 4223-4240, 1999.

Meyer, C., Gravity Wave Interactions with Mesospheric Planetary Waves: a Mechanism for Penetration into the Thermosphere-Ionosphere System, *J. Geophys. Res.,* in press, 1999.

Luo, Y., Manson, A.H., Meek, C.E., Meyer, C.K., and J.M. Forbes, Quasi 16-day Oscillations in the Mesosphere and Lower Thermosphere at Saskatoon, 1980-1996, *J. Geophys. Res.*, submitted, 1999.

**Interactions/Transitions (Papers presented by C. Meyer):**

"Gravity Wave Interactions With the Diurnal Tide" (Poster), CEDAR Workshop, June 1997.

"Gravity Wave Parameterizations for the Global Scale Wave Model", WINDS 97 Workshop, Ann Arbor, MI, October 1997.

"Gravity Wave Modification of the Diurnal Propagating Tide" (Poster), American Geophysical Union Fall Meeting, December 1997.

"Gravitry Wave Interactions with the Diurnal Propagating Tide", DYSMER Symposium, Kyoto, Japan, March, 1998.

"Gravity Wave Interactions with Mesospheric Planetary Waves: a Mechanism for Penetration into the Thermosphere-Ionosphere System" (Poster), CEDAR Workshop, June 1998.

"Gravity Wave Interactions with Mesospheric Planetary Waves: a Mechanism for Penetration into the Thermosphere-Ionosphere System" (Poster), American Geophysical Union Fall Meeting, December 1998.

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